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⑨ Apparatus for drying manure and similar residual products.

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**EP 0 015 357 B1**

### Description

The present invention relates to an apparatus for drying manure and similar residual products which apparatus includes a heating chamber having an associated heating device for the heating of manure in a drying chamber disposed thereover and separated from the heating chamber by means of its bottom wall, and a condensation device which is connected to the drying chamber for receiving vapours evaporated from the manure in the drying process and for condensation thereof. In the British patent specification GB—A—155 493 there is described an apparatus for drying materials, which apparatus includes a heating chamber having an associated device for heating the materials in a drying chamber disposed thereover and separated from the heating chamber by its bottom wall and an agitator disposed in the drying chamber and having at least one agitator arm to be moved as closely to the bottom wall as practicable, the bottom wall having on its underside strengthening ribs for enhancing the rigidity of said bottom wall, and the bottom wall being so supported to permit considerable expansion and contraction. From the British patent specification GB—A—398 628 it is known to move an agitator arm in contact with the bottom wall.

Finally, the patent specification US—A—3 004 347 discloses a method for removing a volatile organic liquid from a solid material.

A problem in prior art drying apparatuses is the vapours, which during the heat treatment evaporate from the manure. Although the amount delivered to the atmosphere is small, this vapour part will cause an embarrassing smell in the vicinity and in the surroundings of the drying apparatus.

The object of the invention is to obtain a drying apparatus of the kind mentioned above, which apparatus eliminates the above-mentioned drawback.

In accordance with the invention, the apparatus is provided with an expelling fan for expelling said vapours from the drying chamber to the condensation device. Moreover, a buffer vessel is provided, which has a large volume for serving as a buffer storage for the residual gas obtained in the condensation device and eventually for the collection of condensate water. A connection conduit extends from the buffer vessel and is provided for supplying the residual gas adjacent to the air inlet of said burner for combustion together with air in the heating chamber.

The invention is described in further details below with reference to the accompanying drawings.

Fig. 1 is a fragmentary section view through an apparatus according to the invention for drying manure, taken along lines I—I in Fig. 3.

Fig. 2 is a top view of the agitator arm of the drying apparatus.

Fig. 3 is a cross section view of the drying

apparatus in Fig. 1, taken along lines III—III in Fig. 1.

In the following description the drying apparatus according to the invention, by way of example only, is used for drying fowl manure. However, the drying apparatus can be used for all kinds of similar residual products, including digested sludge from sewage treatment plants.

Fig. 1 shows a prior art apparatus for drying manure, which apparatus is provided with means according to the invention. The drying apparatus is made of steel and stands on a foundation 2. The drying apparatus has bottom heat chamber 3 which communicates with a heating device 4, e.g. an oil burner. Above the heat chamber a drying chamber 5 is provided separated from the heat chamber by means of its bottom wall 6 having a plane upper surface. An agitator 7 is provided with a shaft 8 centrally located in drying chamber

5 which has a preferred circular cross section shape. Agitator 7 at the lower portion of shaft 8, which is located adjacent to the bottom wall 6, has a rigid agitator arm 9 attached thereto, which arm along its extension contacts the upper surface of the bottom wall 6. A motor 11 connected to shaft 8 is supported on a frame on the top of the apparatus. The motor is arranged for rotating shaft 8 and the agitator arm 9 which will stir up manure from the bottom wall and prevent manure from baking to said surface. Manure to be dried is supplied to the drying chamber through a supply opening closed by means of a door 10. Shaft 8 has a not shown guide on the bottom wall 6.

Shaft 8 is supported on a frame on the top of the apparatus. The motor is arranged for rotating shaft 8 and the agitator arm 9 which will stir up manure from the bottom wall and prevent manure from baking to said surface. Manure to be dried is supplied to the drying chamber through a supply opening closed by means of a door 10. Shaft 8 has a not shown guide on the bottom wall 6.

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operating temperature which is approximately 200°C. Thus, when the drying apparatus is not in operation, viz. is not heated, there is a clearance or space between the peripheral circumferential edge of the bottom wall and the side wall of the drying chamber, which clearance permits the bottom wall to expand freely, when subjected to heat. This expansion in radial direction is not prevented by the side walls of the drying apparatus and so the bottom wall will not be subjected to any buckling. Thus, agitator arm 9 will contact the upper surface of the bottom wall when shaft 8 is rotated. For purpose of reinforcement radial ribs 15 are provided on the bottom side of bottom wall 6, said ribs comprising flat iron bars, each being spot welded at one of their narrow sides to the bottom wall. Ribs 15 are uniformly spaced around the bottom wall. In Fig. 3 three ribs 15 are shown in dashed lines.

For securing the positioning of bottom wall 6 such that the door 51 made therein to the discharge box 50 will be in correct position over the discharge box short radial notches 13 are made in the bottom wall around its circumference. The notches 13 cooperate with vertical shoulders 14 on the upper side of the rim 12. Said shoulders preferably have the same height as the thickness of the bottom wall in order not to be of hindrance to the rotating agitator arm.

A pressure arm 30 is disposed between shaft 8 and the agitator arm 9. Spaced from the lower portion of shaft 8 there is around the shaft clamped a collar 31 having two projecting parallel ears 32 between which an axle bar 33 is mounted. Two opposing ears 34 having an intermediate axle bar 35 are disposed on the upper side of the agitator arm 9. The pressure arm 30 which in a preferred embodiment of the agitator assembly includes two sections 36, 37 and an intermediary biasing means 38 is fixed at its ends to said axle bars by means of bushings. Thus, pressure arm 30 is pivotally supported at its both ends.

Section 36 of the pressure arm connected to shaft 8 has a first pipe with a flange 39 at its free end. Section 37 of the pressure arm connected to the agitator arm 9 has a second pipe with a small diameter, which pipe is movably supported in said first pipe. Spaced from said first pipe a stop 40 is fixed to the second pipe. The biasing means 38 is placed between stop 40 and flange 39 on the first pipe, and has the shape of a pressure spring for urging agitator arm 9 against bottom wall 6.

Thus, pressure arm 30 urges the agitator arm 9, which at its point of attachment to shaft 8 is rotatably supported around a shaft 42, against the bottom wall. Agitator arm 9 is made of a resistant rigid material to be substantially plane in operation.

Agitator arm 9 has two sections, viz. one radial section 43 connected to shaft 8 and an outer section 44 positioned in the same plane but somewhat angles in the direction of rotation (referenced with arrow 45). Owing to this a pocket 46 is formed towards which manure scraped from

the bottom is gathered when agitator arm 9 is rotated in the drying chamber. Pocket 46 has a radial position over door 51 so that dried manure for the purpose of discharging is scraped down into the discharge box 50 when door 51 is open. Moreover agitator arm 9 along its forward portion seen in the direction of rotation may have a longitudinal section 47 of particularly resistant material.

- 10 In the drying apparatus the discharge 50 extends below the bottom of heat chamber 3, there having a collecting pocket 52 the volume of which permits reception of the entire badge of manure which in one operation cycle is dried in the drying chamber. Discharge box 50 occupies a section of heat chamber 3 separated therefrom by means of walls and has a transmission part to the collecting pocket 52. The latter has an outwardly and upwardly sloping bottom and a conveyor 53, preferably a screw conveyor, is provided for conveying the dried manure material from the collecting pocket. Owing to this the drying apparatus can be operated substantially continuous such that the uneconomical starting phase for heating the drying apparatus to its operating temperature is eliminated.
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For eliminating the problem of smell around the drying apparatus an expelling fan 23 is provided to positively expel to the condensation device 20 the vapours obtained in the drying of manure. Owing to this a negative pressure or a vacuum is created in the drying chamber and so there will be no leakage of vapours to the ambient atmosphere.

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In the embodiment illustrated in Fig. 1 a dome 21 is provided in the roof of the drying chamber for collecting the vapours obtained in the drying process. At least one, and preferably two discharge conduits 24 connect dome 21 to the condensation device 20 which is a conventional heat exchange assembly for cooling the vapours conveyed thereto for condensation. The impeller 23 of fan 22 is positioned in dome 21 and arranged to expel said vapours to the condensation device 20. The impeller 23 and the shaft of the impeller is made of a material which is highly resistant to said vapours. A conduit 25 connects the output of the condensation device to a collecting vessel 26 for condensation water and residual gas. From the upper portion of collecting vessel 26 a conduit 27 extends to heat chamber 3 for the transfer of the residual gas thereto.

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Conduit 27 opens to heat chamber 3 adjacent to heating device 4 which is a burner for fossil combustibles. In the embodiment illustrated in Fig. 1 the burner is a gas or oil burner 4. In this embodiment conduit 27 opens adjacent to the air inlet of the burner 4 and so the residual gas obtained in the condensation is fed through the air inlet into the heat chamber, there being subjected to combustion together with fresh air and the combustible of the burner.

Collecting vessel 26 has a large volume for serving as a buffer storage for residual gas when the burner is off.

**Claim**

Apparatus for drying manure and similar residual products, which apparatus includes a heating chamber (3) having an associated heating device for heating manure in a drying chamber (5) disposed thereover and separated from the heating chamber by means of its bottom wall (6), and a condensation device (20) which is connected to the drying chamber (5) for receiving vapours evaporated from the manure in the drying process and for condensation thereof, characterized in that an expelling fan (22, 23) is provided for expelling said vapours from the drying chamber (5) to the condensation device (20); that a buffer vessel (26) is provided which has a large volume for serving as a buffer storage for the residual gas obtained in the condensation device and eventually for the collection of condensate water, and that a connection conduit (27) extending from the buffer vessel is provided for supplying the residual gas adjacent to the air inlet of a burner for combustion together with air in the heat chamber.

**Revendication**

Appareil pour le séchage du fumier et de produits résiduels similaires, ledit appareil comprenant une chambre (3) de chauffage, comportant un dispositif de chauffage associé pour chauffer du fumier dans une chambre (5) de séchage disposée au-dessus et séparée de la chambre de chauffage au moyen de sa paroi de fond (6), et un dispositif de condensation (20) qui est relié à la chambre de séchage (5) pour recevoir des vapeurs provenant du fumier durant le procédé de séchage et pour les condenser, caractérisé en ce qu'il est prévu un ventilateur d'expulsion (22, 23) pour chasser lesdites vapeurs de la chambre de

séchage (5) dans le dispositif de condensation (20), une cuve tampon (26) possédant un volume important, pour être utilisée comme dispositif de stockage tampon pour le gaz résiduel obtenu dans le dispositif de condensation et éventuellement pour la récupération de l'eau de condensat, et en ce qu'une canalisation (27) s'étendant à partir de la cuve tampon est prévue pour fournir le gaz résiduel à proximité de l'entrée d'air du brûleur pour sa combustion avec l'air dans la chambre de chauffage.

**Patentanspruch**

15 Eine Vorrichtung zum Trocknen von Dünger und ähnlichen Abfallsprodukten, welche Vorrichtung eine Heizkammer (3) umfasst mit dazugehörender Heizvorrichtung zum Heißen von Dünger in einer darüber eingerichteten und von der Heizkammer via ihre Bodenwand (6) abgegrenzten Trockenkammer (5), und eine mit der Heizkammer (5) verbundene Kondensationsvorrichtung (20), zur Aufnahme der beim Düngetrocknen abgegebenen Dünste und zur deren Kondensation, dadurch gekennzeichnet, dass ein Ausstiegsventilator (22, 23) zur Austreibung der fräglichen Dünste von der Trockenkammer (5) in die Kondensationsvorrichtung (20) eingerichtet ist; dass ein Sammelgefäß (26), das einen grossen Rauminhalt hat, als Pufferlager für das Restgas, das in der Kondensationsvorrichtung entsteht, und evtl. zum Sammeln von Kondensatwasser eingerichtet ist, und dass eine Verbindungsleitung (27), die sich von dem Sammelgefäß erstreckt, eingerichtet ist, um das Restgas an die Lufteinmündung des genannten Brenners zur Verbrennung in der Heizkammer zusammen mit Luft zu führen.

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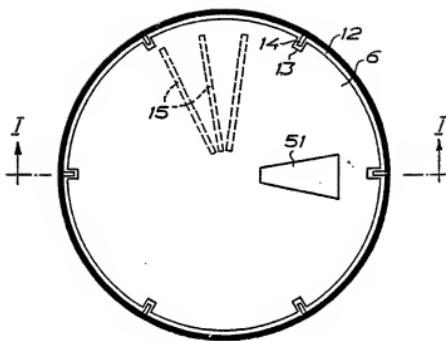


FIG. 3